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Micropower Timing Circuit

Jameco Part Number 34930

GENERAL DESCRIPTION

The XR-L555 is a stable micropower controller capable of producing accurate timing pulses. It is a direct replacement for the popular 555-timer for applications requiring very low power dissipation. The XR-L555 has approximately 1/15th the power dissipation of the standard 555-timer and can operate down to 2.7 volts without sacrificing such key features as timing accuracy and frequency stability. At 5-volt operation, typical power dissipation of the XR-L555 is 900 microwatts.

The circuit contains independent control terminals for triggering or resetting if desired. In the monostable mode of operation, the time delay is controlled by one external resistor and one capacitor. For astable operation as an oscillator the free-running frequency and the duty cycle are accurately controlled with two external resistors and one capacitor as shown in Figure 2. The XR-L555 is triggered or reset on falling waveforms. Its output can source up to 100 mA or drive TTL circuits.

Because of its temperature stability and low-voltage (2.7V) operation capability, the XR-L555 is ideally suited as a micropower clock oscillator or VCO for low-power CMOS systems. It can operate up to 1500 hours with only two 300 mA-Hr batteries.

FEATURES

Pin Compatible with Standard 555 Timer
Less than 1 mW Power Dissipation (V+ = 5V)
Timing from Microseconds to Minutes
Over 1000-Hour Operation with 2 Batteries
Low Voltage Operation (V+ = 2.7V)
Operates in Both Monostable and Astable Modes
CMOS TTL and DTL Compatible Outputs

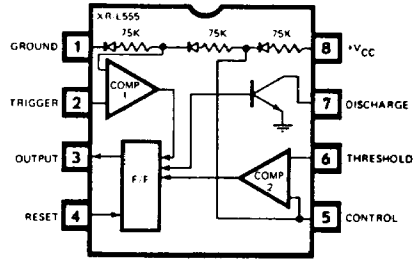
APPLICATIONS

Battery Operated Timing
Micropower Clock Generator
Pulse Shaping and Detection
Micropower PLL Design
Power-On Reset Controller
Micropower Oscillator
Sequential Timing
Pulse Width Modulation
Appliance Timing
Remote-Control Sequencer

ABSOLUTE MAXIMUM RATINGS

Power Supply	18 volts

FUNCTIONAL BLOCK DIAGRAM



Power Dissipation (package limitation)	
Ceramic Package	385 mW
Plastic Package	300 mW
SO-8	225 mW
Derate above +25°C	2.5 mW/°C
Storage Temperature	−65°C to +125°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-L555N	Ceramic	0°C to +70°C
XR-L555CN	Ceramic	0°C to +70°C
XR-L555CP	Plastic	0°C to +70°C
XR-L555MD	Japanese SOIC SO-8	0°C to +70°C

SYSTEM DESCRIPTION

The XR-L555 is a micropower timing circuit similar to the industry standard 555-type timer. It is not a direct replacement for a CMOS 555 timer. It is capable of both monostable and astable operation with timing intervals ranging from low microseconds up through several hours. Timing is independent of supply voltage which may range from 2.7 V to 15 V. The output stage can source 100mA.

In the monostable (one shot) mode, timing is determined by one resistor and capacitor. Astable operation (oscillation) requires an additional resistor, which controls duty cycle. An internal resistive divider provides a reference voltage of 2/3 V_{CC}, the interval is independent of supply voltage; however, for maximum accuracy, the user should ensure V_{CC} does not vary during timing.

The output of the XR-L555 is high during the timing interval. It is triggered and reset on falling waveforms. The control voltage input (Pin 5) may serve as a pulse width modulation point.

For applications requiring dual L555-type timers, see the XR-L556.

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ELECTRICAL CHARACTERISTICS

Test Conditions: (T_A = 25°C, V_{CC} = +5V, unless otherwise specified.)

PARAMETERS	XR-L555N			XR-L555C			UNITS	CONDITIONS
	MIN	TYP	MAX	MIN	TYP	MAX		
Supply Voltage	2.7		15	2.7		15	V	
Supply Current		150	300		190	500	μA	Low State Output V_{CC} = 5V, R_L = ∞
Timing Error								R_A, R_B = 1 KΩ to 100 KΩ
Initial Accuracy		0.5	2.0		1.0		%	C = 0.1 μF
Drift with Temperature		30	100		50		ppm/°C	0°C ≤ T_T ≤ 70°C *
Drift with Supply Voltage		0.05			0.05		%/V	
Threshold Voltage		2/3			2/3		x V_{CC}	
Trigger Voltage	1.45 4.8	1.67 5.0	1.9 5.2		1.67 5.0		V V	V_{CC} = 5V V_{CC} = 15V
Trigger Current		0.5			0.5		μA	
Reset Voltage	0.4	0.7	1.0	0.4	0.7	1.0	V	
Reset Current		0.1			0.1		mA	
Threshold Current		0.1	0.25		0.1	0.25	μA	
Control Voltage Level	2.90 9.6	3.33 10.0	3.80 10.4	2.60 9.0	3.33 10.0	4.00 11.0	V	V_{CC} = 5V V_{CC} = 15V
Output Voltage Drop (Low)		0.1	0.3		0.25	0.35	V	I_{sink} = 1.5 mA
Output Voltage Drop (High)								I_{source} = 10 mA
	3.0	3.3		2.75	3.3		V	V_{CC} = 5V
	13	13.3		12.75	13.3		V	V_{CC} = 15V
								I_{source} = 100 mA
		12.5			12.5		V	V_{CC} = 15V
Rise Time of Output		100			100		nsec	
Fall Time of Output		100			100		nsec	
Discharge Transistor Leakage		0.1			0.1		μA	

* These parameters, although guaranteed over the recommended operating conditions, are not 100% tested in production.

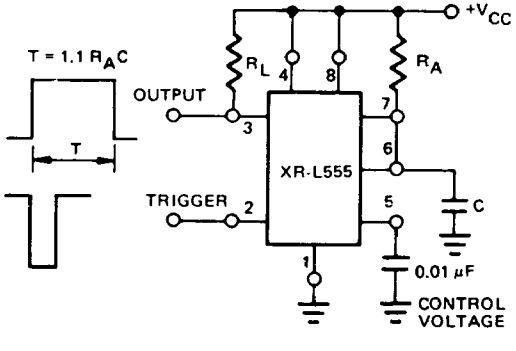

Figure 1. Monostable (One-Shot) Circuit

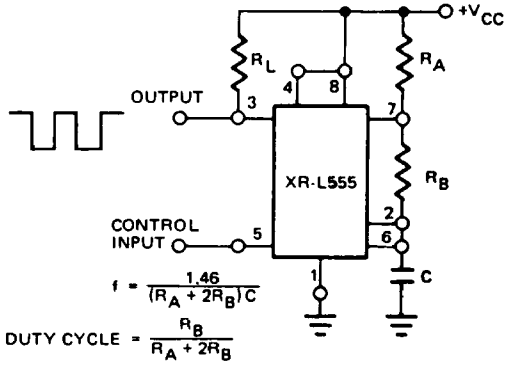

Figure 2. Astable (Free-Running) Circuit

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GENERAL CHARACTERISTICS

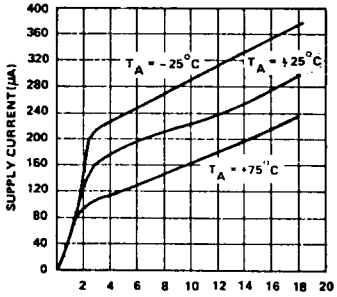

Figure 3. Supply Current as a Function of Supply Voltage

CHARACTERISTIC CURVES

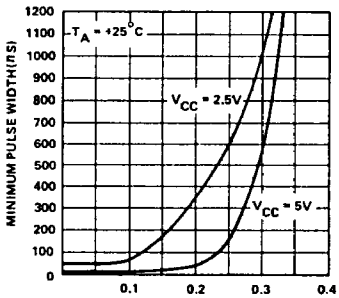

Figure 4. Minimum Pulse-Width Required for Triggering

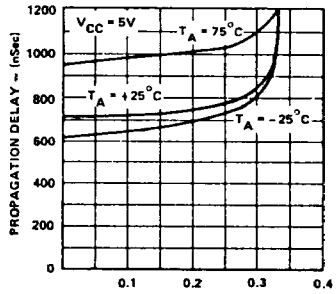

Figure 5. Propagation Delay as a Function of Voltage Level of Trigger Pulse

MONOSTABLE OPERATION

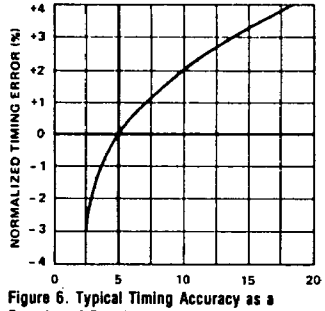

Figure 6. Typical Timing Accuracy as a Function of Supply Voltage

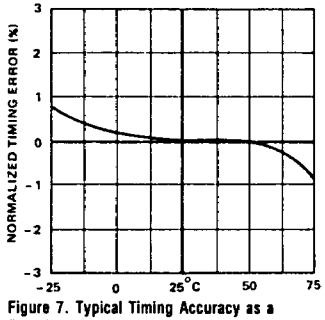

Figure 7. Typical Timing Accuracy as a Function of Temperature (V_{CC} = 5V, R_A = 100KΩ, C = 0.01 μF)

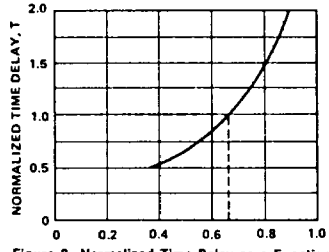

Figure 8. Normalized Time Delay as a Function of Control Voltage

ASTABLE OPERATION

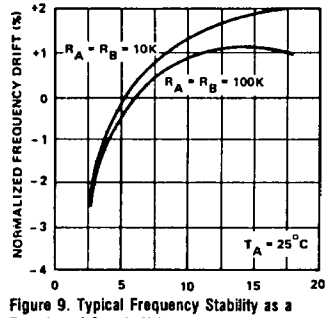

Figure 9. Typical Frequency Stability as a Function of Supply Voltage

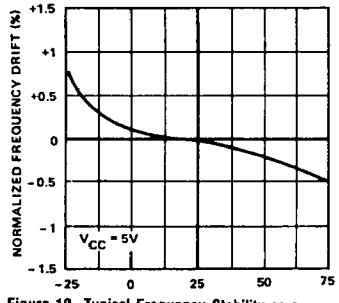

Figure 10. Typical Frequency Stability as a Function of Temperature (R_A = R_B = 10KΩ, C = 0.1 μF)

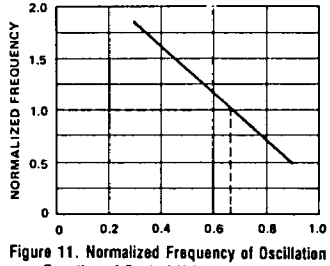

Figure 11. Normalized Frequency of Oscillation as a Function of Control Voltage

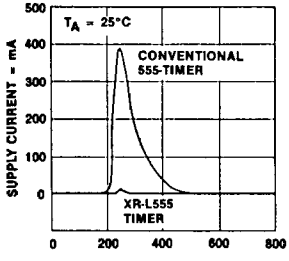

Figure 12. Comparison of Supply Current Transient of Conventional 555-Timer with XR-L555 Micropower Timer

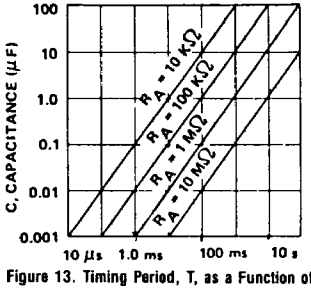

Figure 13. Timing Period, T, as a Function of External R-C Network

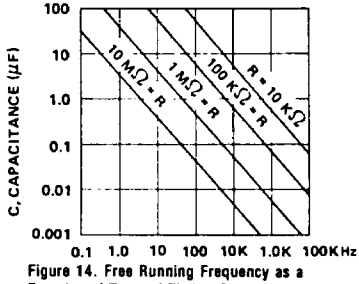

Figure 14. Free Running Frequency as a Function of External Timing Components (Note: R = R_A + 2R_B)

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FEATURES OF XR-L555

The XR-L555 micropower timer is, in most instances, a direct pin-for-pin replacement for the conventional 555-type timer. However, compared to conventional 555-timer, it offers the following important performance features:

Reduced Power Dissipation: The current drain is 1/15th of the conventional 555-timer.

No Supply Current Transients: The conventional 555-timer can produce 300 to 400 mA of supply current spikes during switching. The XR-L555 is virtually transient-free as shown in Figure 12.

Low-Voltage Operation: The XR-L555 operates down to 2.7 volts of supply voltage, vs. 4.5V minimum operating voltage needed for conventional 555-timer. Thus, the XR-L555 can operate safely and reliably with two 1.5V batteries.

Proven Bipolar Technology: The XR-L555 is fabricated using conventional bipolar process technology. Thus, it is immune to electrostatic burn-out problems associated with low-power timers using CMOS technology.

APPLICATIONS INFORMATION

MONOSTABLE (ONE-SHOT) OPERATION

The circuit connection for monostable, or one-shot operation of the XR-L555 is shown in Figure 1. The internal flip-flop is triggered by lowering the trigger level at pin 2 to less than 1/3 of V_{CC}. The circuit triggers on a negative-going slope. Upon triggering, the flip-flop is set to one side, which releases the short circuit across the capacitor and also moves the output level at pin 3 toward V_{CC}. The voltage across the capacitor, therefore, starts increasing exponentially with a time constant $\tau = R_A C$. A high impedance comparator is referenced to 2/3 V_{CC} with the use of three equal internal resistors. When the voltage across the capacitor reaches this level, the flip-flop is reset, the capacitor is discharged rapidly, and the output level moves toward ground, and the timing cycle is completed.

The duration of the timing period, T, during which the output logic level is at a "high" state is given by the equation:

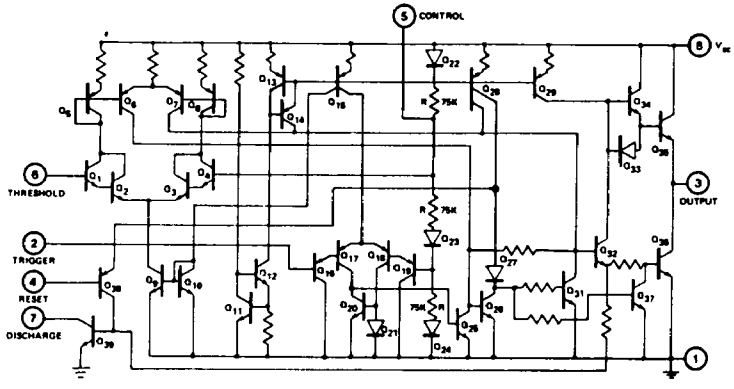
$$T = 1.1\ R_A C$$

The time delay varies linearly with the choice of R_A and C as shown by the timing curves of Figure 13. For proper operation of the circuit, the trigger pulse-width *must be* less than the timing period.

Once the circuit is triggered it is immune to additional trigger inputs until the present timing-period has been completed. The timing-cycle can be interrupted by using the reset control (pin 4). When the reset control is "low", the internal discharge transistor is turned "on" and prevents the capacitor from charging. As long as the reset voltage is applied, the digital output level will remain unchanged, i.e. "low". The reset pin should be connected to $+V_{CC}$ when not used to avoid the possibility of false triggering.

ASTABLE (SELF-TRIGGERING) OPERATION

For astable (or self-triggering) operation, the correct circuit connection is shown in Figure 2. The external capacitor charges to 2/3 V_{CC} through the series combination of R_A and R_B, and discharges to 1/3 V_{CC} through R_B. In this manner, the capacitor voltage oscillates between 1/3 V_{CC} and 2/3 V_{CC}, with an exponential waveform. The oscillations can be keyed "on" and "off" using the reset control. The frequency of oscillation can be readily calculated from the equations in Figure 2 and Figure 14.



EQUIVALENT SCHEMATIC DIAGRAM

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EXAR

XR-1488/1489A

Quad Line Driver/Receiver

GENERAL DESCRIPTION

The XR-1488 is a monolithic quad line driver designed to interface data terminal equipment with data communications equipment in conformance with the specifications of EIA Standard No. RS232C. This extremely versatile integrated circuit can be used to perform a wide range of applications. Features such as output current limiting, independent positive and negative power supply driving elements, and compatibility with all DTL and TTL logic families greatly enhance the versatility of the circuit.

The XR-1489A is a monolithic quad line receiver designed to interface data terminal equipment with data communications equipment. the XR-1489A quad receiver along with its companion circuit, the XR-1488 quad driver, provide a complete interface system between DTL or TTL logic levels and the RS232C defined voltage and impedance levels.

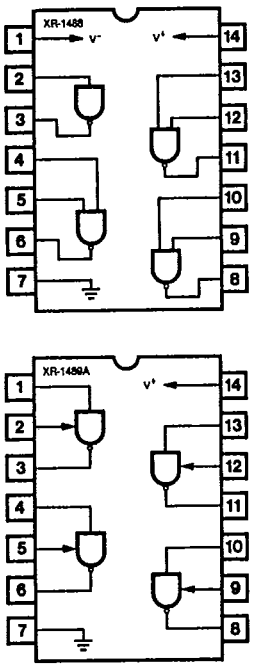
ABSOLUTE MAXIMUM RATINGS

Power Supply	
XR-1488	±15 Vdc
XR-1489A	+10 Vdc
Power Dissipation	
Ceramic Package	1000 mW
Derate above +25°C	6.7 mW/°C
Plastic Package	650 mW/°C
Derate above +25°C	5 mW/°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-1488N	Ceramic	0°C to +70°C
XR-1488P	Plastic	0°C to +70°C
XR-1489AN	Ceramic	0°C to +70°C
XR-1489AP	Plastic	0°C to +70°C

FUNCTIONAL BLOCK DIAGRAMS



SYSTEM DESCRIPTION

The XR-1488 and XR-1489A are a matched set of quad line drivers and line receivers designed for interfacing between TTL/DTL and RS232C data communication lines.

The XR-1488 contains four independent split supply line drivers, each with a ±10 mA current limited output. For RS232C applications, the slew rate can be reduced to the 30 V/μS limit by shunting the output to ground with a 410 pF capacitor. The XR-1489A contains four independent line receivers, designed for interfacing RS232C to TTL/DTL. Each receiver features independently programmable switching thresholds with hysteresis, and input protection to ±30 V. The output can typically source 3 mA and sink 20 mA.

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